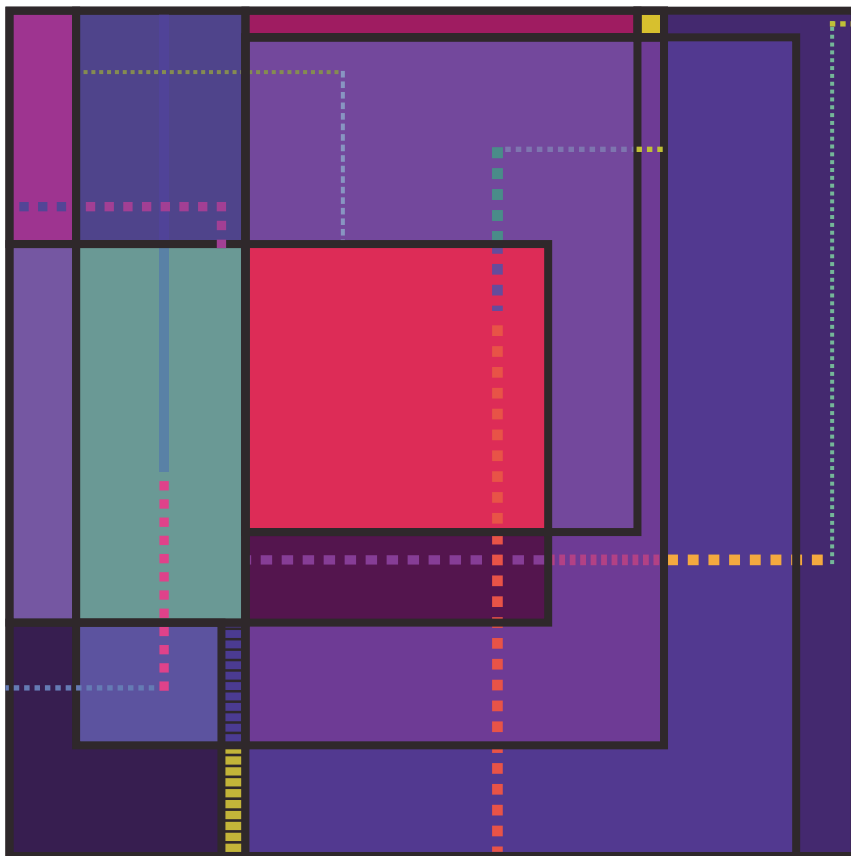




Apple Internet Router Administrator's Guide—Addendum





©WozFest HQ, 2025

Apple, the Apple logo, AppleShare, AppleTalk, EtherTalk, ImageWriter, iMac, iPadOS, LaserWriter, LocalTalk, Macintosh, macOS, and MacTCP are trademarks of [Apple Inc.](#), registered in the U.S. and other countries and regions.

System 7, and TokenTalk are trademarks of Apple Inc.

Use of the “keyboard” Apple logo (Option-Shift-K) for commercial purposes without the prior written consent of Apple may constitute trademark infringement and unfair competition in violation of federal and state laws.

ITC Garamond and ITC Zapf Dingbats are registered trademarks of [Monotype ITC Inc.](#)

Microsoft is a registered trademark of [Microsoft Corporation](#).

Google Docs is a trademark of [Google LLC](#).

[Affinity](#) is a registered trademark of Serif (Europe) Ltd.

[Ubuntu](#) is a registered trademark of Canonical Ltd.

[QEMU](#) is a trademark of Fabrice Bellard.

VNC is a registered trademark of [RealVNC Limited](#).

Oracle is a registered trademark of [Oracle Corporation](#).

Brother is a trademark of [Brother Industries, Ltd.](#)

Other product and company names mentioned herein may be trademarks of their respective companies.

Simultaneously published around the world.

Mention of third-party products is for informational purposes only and constitutes neither an endorsement nor a recommendation. WozFest HQ assumes no responsibility with regard to the performance or use of these products.

Published: 2025-03-07 00:12

Errata should be addressed to: airaga-errata@europius.zone

The **WozFest** Publishing System

The *Apple Internet Router Administrator's Guide—Addendum* was written, edited, and composed at **WozFest** on a desktop publishing system using an Apple [iMac](#) computer, the GlobalTalk network system, Microsoft Word, Google Docs, and Affinity Publisher. Line art was created with Affinity Designer. Screenshots were created using the QEMU emulation system running on a Ubuntu host on Oracle Cloud Infrastructure and captured automatically with [Keyboard Maestro](#) on macOS 15 Sequoia via VNC on macOS and iPadOS. Proof pages were printed on a [Brother laser printer](#). Final pages were output directly to PDF.

Text type and display type are Apple's prior corporate font, a condensed version of ITC Garamond. Bullets are ITC Zapf Dingbats.

About This Addendum

I have prepared this addendum to the *Apple Internet Router Administrator's Guide* in the lead up to [MARCHintosh](#) 2025.

It is the result of my unexpected participation¹ in MARCHintosh 2024 (my first MARCHintosh), during which I not only developed an interest in the “how to” of GlobalTalk participation, but also experienced the joy of seeing such a diverse mix of administrators and systems involved in the GlobalTalk internet.

I successfully raised funds with other node admins to buy an original boxed Apple Internet Router v3.0.1 package on eBay, with manual and disks, and it allowed me to confirm various configuration matters for GlobalTalk networking.

GlobalTalk has continued past 31 March 2024, and my own Apple Internet Router node has remained online for much of that time. There are no plans to retire my node, and I do hope to expand the services offered over it in the years to come.

It was my intention to prepare this addendum in the afterglow of MARCHintosh 2024—however, as often happens with our retrocomputing hobby, “real life” got in the way and it took the approach of MARCHintosh 2025 for me to gather the necessary time and energy to finally tackle this particular labour of love.

And it is, in its own way, a love letter to what the GlobalTalk network is—a veritable ragtag fugitive fleet of retro-enthusiasts looking to re-experience a simpler time of computer networking.

It's important to note that GlobalTalk is more than any single node, or group of nodes, just as it's more than “just another part of” MARCHintosh—it is a community, it is an adventure, it is a learning experience, and it is a *lot* of fun.

So, “Turn On, Log In, (Hopefully Don't) Drop Out”, and have a ball on the weird corner of the Internet that is... #GlobalTalk.

[@europius](#), February 2025

¹“Unexpected” as I no longer have any retro Macintosh computers in my collection.

What this addendum contains

This addendum contains a new chapter for the *Apple Internet Router Administrator's Guide*, Chapter 11—**The GlobalTalk Network**, and additional pages for the Table of Contents.

The addendum is available in several versions:

- A collated *Apple Internet Router Administrator's Guide* PDF, which has the original scanned and OCR'd guide, and the new PDF pages inserted as appropriate—this effectively represents a new edition of the original guide
- An Addendum-only PDF at the same page size as the original manual, with no page or punch marks.
- An Addendum-only PDF with page and punch marks for printing double-sided, cutting down and punching for insertion into an original *Apple Internet Router Administrator's Guide* printed manual. Insert this leaf before Chapter 1, and the following Table of Contents leaf after page vi. The cover leaf can be left out, inserted before Chapter 11, or inserted at the end of the manual.

Thanks!

This addendum, and GlobalTalk, wouldn't have been possible without some key players. I can't hope to name them all, but those I especially wish to say "Thanks" to include:

- [@paulrickards](#) and [@billgoats](#), the "Original GlobalTalkers", and their partner in crime [@vga256](#), who coined the name
- My fellow retro-enthusiasts who helped me to buy an original Apple Internet Router package, making this addendum possible: [@ctb31](#), [@Jongleur](#), [@LikesOldMacs](#), [@billgoats](#), [@RetroSwim](#), [@DrJosh9000](#)
- Those who proofread this addendum and offered invaluable guidance: [@LikesOldMacs](#), [@danieltufvesson](#), [@rajiv](#), [@arroz](#), [@dldnb](#), [@RtoD](#), [@kalleboo](#)
- The GlobalTalk participants who prepared information resources and useful (and/or fun) applications (especially those I list in this addendum), who left messages in drop boxes, sent print jobs, and celebrated GlobalTalk whenever they could
- The MARCHintosh admins
- And lastly, but certainly most importantly, a heartfelt thanks goes out to all those "AppleTalk internet administrators" who took the effort to create GlobalTalk nodes, making it truly a "net to remember"

11 The GlobalTalk Network / A-1

GlobalTalk—a background / A-2

A short history of AppleTalk / A-2

GlobalTalk—a phenomenon 40 years in the making / A-2

GlobalTalk technical basics / A-4

System requirements overview / A-4

Beyond the basics / A-5

Joining GlobalTalk first steps / A-6

Real vs emulated hardware / A-7

Host system vs emulated system / A-8

QEMU / A-8

Other emulation systems / A-9

Connecting to Ethernet / A-10

Built-in, expansion cards, BlueSCSI WiFi / A-10

Network speed considerations / A-10

Bridged vs NAT networking for emulated systems / A-11

Network numbering and zones / A-12

LocalTalk vs EtherTalk network numbers / A-12

Network ranges / A-12

Claiming network numbers and ranges on GlobalTalk / A-12

When ranges overlap / A-13

AppleTalk zones / A-13

CGNAT and Tier 1 VPNs / A-14

NAT hairpinning / A-15

Network router configuration / A-15

DHCP and DHCP reservation vs manual address / A-15

IP address vs hostname / A-16

Dynamic DNS / A-16

Port forwarding / A-17

GlobalTalk software set up / A-18

Network services configuration / A-18

Apple Internet Router setup—a walkthrough / A-21

GlobalTalk troubleshooting basics / A-28

TCP, UDP and IP issues / A-28

AppleTalk issues / A-29

System issues / A-29

Backing up / A-30

GlobalTalk network services / A-31

File sharing / A-31

AppleShare / A-31

Netatalk / A-31

Other file servers / A-31

Users and permissions / A-32

Printing / A-32

LocalTalk printers / A-32

Laser printers and PPDs / A-32

Printing to PDF / A-33

CUPS and Netatalk / A-33

Other services / A-33	
Gaming / A-33	
PowerTalk and AppleMail / A-33	
BBSes, forums and chat / A-34	
Network backups / A-34	
MacIP Gateway / A-34	
Useful utilities and resources / A-35	
Router Manager 3.0.1W / A-35	
AIRConfig / A-36	
GlobalTalk Updater / A-36	
Pre-prepared Host ID files for AIRConfig / A-37	
Disinfectant / A-37	
MacTCP Ping / A-37	
MacPing Pro / A-38	
Trawl / A-38	
TalkCrawler / A-39	
Who's There / A-39	
Inter•Poll Admin / A-40	
Choosier / A-41	
timelord/tardis / A-41	
QuickDraw Viewer / A-42	
Mac OS X/Netatalk command line AppleTalk utilities / A-42	
atlookup (Mac OS X) / A-42	
nbplkup and getzones (Netatalk) / A-43	
Experimentation on the command line / A-43	
Mind the (AIR) gap—other AppleTalk bridges and routers / A-44	
Solutions contemporaneous with Apple Internet Router / A-44	
LocalTalk Bridge / A-44	
GatorBox / A-44	
Cisco / A-44	
Modern solutions / A-45	
jroutel / A-45	
TashTalk / A-45	
TashRouter / A-45	
AirTalk / A-45	
StarTalk/LT / A-45	
Security on GlobalTalk / A-46	
Google account / A-46	
IP address/hostname / A-46	
Port forwarding / A-46	
Insecure services / A-47	
Berserk print jobs / A-47	
Viruses / A-47	
A vision of GlobalTalk's future / A-49	

11 The GlobalTalk Network

This chapter gives an overview of the GlobalTalk network—what it is, how it formed, and how AppleTalk network administrators can connect to it. Guidance on matters relating to networking and the Apple Internet Router software for use on GlobalTalk is given to facilitate joining this truly global phenomenon.

GlobalTalk—a background

A short history of AppleTalk

In 1984 Apple Computer, Inc. introduced the Macintosh and changed everyday computing forever with its accessible GUI.

A year later, Apple introduced AppleTalk, its new networking protocol, and LocalTalk, its new networking connection hardware, for connecting Macintoshes, Lisas, Apple IIs, and LaserWriters (plus the occasional IBM PC-compatible via an ISA expansion card, released in 1987).

Plug-and-Play had come to networking with the introduction of AppleTalk, and with no configuration, a network of devices could auto-negotiate its own network topology. AppleTalk “zones” could be connected via hardware bridges to connect, for example, computers in different company departments.

In the following years, EtherTalk (AppleTalk over Ethernet), Token Ring support, AppleShare (Apple’s network file server implementation), and, perhaps most importantly, AppleTalk Phase 2 were released.

AppleTalk Phase 2 took network configuration from a hardware-based model to more a software-defined model, and increased the number of nodes supported per segment to 253.

Networks could be joined via remote connections, zones could co-exist on single physical networks, and software such as Apple Internet Router allowed AppleTalk network administrators to connect networks around the globe via EtherTalk and Token Ring networks, with little need to consider underlying network transport protocols or hardware transport layers.

AppleTalk was abandoned by Apple with the release of Mac OS X v10.6 Snow Leopard in 2009.

GlobalTalk—a phenomenon 40 years in the making

In preparation for MARCHintosh 2024, several Apple retrocomputing enthusiasts (principally [@paulrickards](#), [@billgoats](#), and [@vga256](#)) worked on establishing connections between their AppleTalk networks over the Internet in the second half of February 2024.

After trying several solutions, they settled on Apple Internet Router, and made their first successful connection at the end of February—other nodes started joining the nascent GlobalTalk¹ “internet” in early March 2024.

¹The name “GlobalTalk” was coined by [@vga256](#) on [26 February 2024](#)

In short order, numerous retrocomputing enthusiasts expressed a desire to connect, a coordinating spreadsheet was created, and nodes began appearing from around the world.

Some enthusiasts had physical Macintoshes which were compatible with Apple Internet Router, while others relied on emulated machines.

Whichever type of machine acted as the primary AppleTalk router for a node, by the end of the month, it was not uncommon to see over 50 nodes connected at any one time.

And the machines “behind” those AppleTalk routers ranged from original Macintoshes, Lisas, and Apple IIs, to modern clones, virtualised systems, Windows servers, and printers by the truckload (dot matrix, inkjet and laser).

Some nodes, such as my own, had no original hardware in place—only virtualised computers and modern printers.

However, the joy of connecting to such an antiquated system which proved to be robust and relatively easy to set up, was shared by all node administrators, even if there were occasional hiccups.

This chapter aims to describe the GlobalTalk network in terms of Apple Internet Router and its configuration, discusses networking requirements to support downtime-tolerant connections between GlobalTalk nodes, refers to the original guide for some details, and, lastly, considers methods of connecting nodes other than Apple Internet Router (both hardware and software).

◆ **Note** In this chapter, I distinguish between “internets” as used in the *Apple Internet Router Administrator’s Guide*, i.e. an “internetwork” of networks, and “the” Internet, by specifying “AppleTalk internet/s” where the internetwork of AppleTalk networks provided via Apple Internet Router nodes is meant. GlobalTalk is simply an AppleTalk internet using IP tunnelling as defined in the *Apple Internet Router Administrator’s Guide*. ◆

◆ **Note** In this chapter, when “LocalTalk” is stated in relation to hardware, any LocalTalk-compatible hardware, such as PhoneNet, can be taken as being included. It is up to the reader to determine the best mix of hardware for the devices on their network/s. ◆

◆ **Note** In this chapter, when “EtherTalk” is stated, “TokenTalk” (AppleTalk over a Token Ring network) can be considered to be included in the reference. If any administrators have a TokenTalk network attached to GlobalTalk, they will need to consider any TokenTalk-specific information provided in other chapters of this guide. ◆

GlobalTalk technical basics

System requirements overview

At an abstract level, the requirements for joining GlobalTalk are relatively modest—however, they can be very specific.

- For basic connectivity, you need the following components:
- Membership of the Google Sheet which coordinates nodes and their basic connection details (see the section “[Joining GlobalTalk first steps](#)” later in this chapter)
- A real or virtual Macintosh computer capable of running Apple Internet Router v3 (see the section “System Requirements” in Chapter 2 and the section “[Real vs emulated hardware](#)” later in this chapter)

◆ **Note** While Chapter 2 specifies “System 7.0 or later”, Apple Internet Router runs best on System 7.1.x, is not compatible with later versions (some have reported success with System 7.5, but that is beyond the scope of this chapter), is not compatible with PowerPC Macintoshes, is not compatible with OpenTransport...you get the idea. ◆

◆ **Note** MacTCP v1 and v2 are both compatible with Apple Internet Router, but each have issues. MacTCP v1 is unable to resolve more than 8 CNAME DNS records in the Host IDs list—pre-resolved lists can be downloaded from some GlobalTalk nodes (see [Pre-prepared Host ID files for AIRConfig](#) later in this chapter). MacTCP v2 removes this limitation, but the Apple Internet Router logs get filled with gobbledegook messages. It is suggested to use MacTCP v1 until a GlobalTalk router’s connection is stable, at which time the administrator may wish to use the later version. It has been observed that Apple Internet Router creates much larger log files under MacTCP v2 because of these spurious status messages, so admins may wish to periodically rotate them. ◆

- An Ethernet connection for the Apple Internet Router host (see the sections “[Connecting to Ethernet](#)” and “[Network numbering and zones](#)” later in this chapter)
- An internet connection, ideally with a publicly-routable IP address (see the section “[CGNAT and Tier 1 VPNs](#)” later in this chapter)
- An ability to forward UDP port 387 to the Apple Internet Router host (see the section “[Network router configuration](#)” later in this chapter)

With these items in hand, you can connect to and begin exploring GlobalTalk before expanding out with more complex network configurations.

For example, the following can be added to the network:

- If your Apple Internet Router host has serial ports, additional LocalTalk segments can be added (one per port, see the section “[Network numbering and zones](#)” later in this chapter)
- AppleShare servers can be established to share retro-Macintosh programs and files (see the section “[File sharing](#)” later in this chapter)
- Printers can be made accessible to other GlobalTalk users (see the section “Printing” later in this chapter)
- Other AppleTalk aware programs, such as HyperCard, network-capable games (e.g. Bolo, Avara, Marathon, and Spectre), or BBS systems, can access—or provide—resources across the GlobalTalk network (see the section “[Other services](#)” later in this chapter)
- The AppleTalk network can be explored using several assessment and discovery tools (see the section “[Useful utilities and resources](#)” later in this chapter)
- Third party hardware AppleTalk bridges and software AppleTalk routers can be installed (see the section “[Mind the \(AIR\) gap—other AppleTalk bridges and routers](#)” later in this chapter)

Beyond the basics

While this chapter should be enough to guide you to connecting your Apple Internet Router host and perhaps some additional devices to your network, delving into the arcana of AppleTalk, Apple Internet Router, and the services and devices mentioned in this chapter is beyond the scope of such an addendum.

Consider, then, this chapter as a series of signposts, some with useful information, others redirecting you to the chapters, websites, and people where you will be able to find the information you need.

There is plenty yet to be discovered, and it is left as an exercise for the reader, in collaboration with other node administrators, to embark on the adventure of playing on the GlobalTalk network.

Joining GlobalTalk first steps

While there are some “Wild West” aspects to GlobalTalk, ensuring node visibility requires coordination regarding network numbers (see the section “Identifying networks on an internet” in Chapter 4 and the section “Specifying network ranges” in Appendix A).

To that end, a shared Google Sheet was established by the first node administrators to help such coordination.

The administration of the spreadsheet was handed over to the MARCHintosh organisers early in GlobalTalk’s life, and they manage it to this day.

While there are some basic behavioural rules set by the organisers, the basic expectation is that node administrators will work collaboratively together on configurations and any zone name or network number conflicts.

GlobalTalk has proven to be a hotbed of collaboration on topics ranging from basics like AppleTalk network design to the arcana of Docker images for Apple Internet Router and configuration of bridged networking in Linux for the QEMU emulation system, through to fun and games with Bolo servers being set up and chat systems being created in HyperCard specifically for GlobalTalk.

Head on over to the base GlobalTalk page at <https://marchintosh.com/globaltalk.html> (or http for older computers), read the basics and then follow the link to the *GlobalTalk Signup Form*.

Provide the requested information, and the application will be (manually) reviewed and approved, at which point an invite will be sent to your e-mail address with a link to the shared Google Sheet.

◆ **Note** A Google account is required to join the Sheet. This can be a GMail account, or your account using your usual e-mail, but you can only join with a Google Account. Your Google Account address will be visible to other node administrators. If this is a privacy concern for you, consider creating a dedicated Google Account for GlobalTalk use only. See also the section “[Security on GlobalTalk](#)” later in this chapter. ◆

Once you are on the spreadsheet, you may wish to add some additional details or expand your original answers.

At some point you’ll need to enter network number/s for any LocalTalk zone/s you are connecting to GlobalTalk, and a range of network numbers for EtherTalk connections.

Review the list for currently claimed numbers before settling on your own, as network numbers ***must be unique*** and ranges ***must not overlap*** with any other network numbers or ranges.

When starting out, a network range of just one number should be selected (see the section “[Network numbering and zones](#)” later in this chapter for more details on network numbers).

Real vs emulated hardware

Great satisfaction can come from establishing connections to networks like GlobalTalk on original hardware.

Extending the technology beyond either what was envisaged “back in the day”, or achievable by our younger selves (and their usually tight budgets) can be a wonderful learning experience and adventure for retro-computer enthusiasts.

Some of us, however, no longer have wide enough collections (or any collection) of the sorts of devices which can connect to AppleTalk networks.

But we might have memories of using such devices, or a desire to learn about such devices and networking technologies, and therefore can’t rely on original hardware.

The thrill is still present, even if it sometimes takes on different forms.

Original hardware and emulated systems are equal citizens when it comes to GlobalTalk. Emulation has become so good that the network software neither knows nor cares if it’s running on emulated hardware.

For those of us without the necessary hardware, several GlobalTalk node administrators have put together guides and setup files for various emulated systems to establish GlobalTalk connections and begin exploring the network.

◆ **Aside** The computers I have on my GlobalTalk node (a Quadra 800, a PowerPC Mac OS 9 machine, and a PowerPC Mac OS X v10.3 machine) are all virtual, but can access all GlobalTalk resources as if they were real computers. While AppleShare services could be provided by my Quadra 800, I use Netatalk 4 (which saw the return of AppleTalk networking after its absence in v3) for file sharing. I have a modern Brother printer and a Print to PDF printer created via CUPS (the Common Unix Printing System) on my AppleTalk network via Netatalk 4 printer sharing. ◆

Host system vs emulated system

When emulating another computer, references are often made to the “host” system. This is the system on which the emulation software runs.

For example, many GlobalTalk administrators are running QEMU on Linux or Windows—in this case, Linux and Windows are the host systems for the emulated QEMU system.

QEMU

The QEMU engine emulating a Quadra 800 with System 7.1 seems to be the most popular emulated hardware to act as an Apple Internet Router host.

Some guides and resources to get started with this system are at:

[@europlus: GlobalTalk Setup Files](#)

Base files to create a QEMU emulated Quadra 800, includes a 2GB disk image with System 7.1 and Apple Internet Router v3.0.1 pre-installed, ready for configuration. A [UTM](#) configuration file is now available.

◆ **Note** The .img disk image files (pre-installed and installer-based) are compatible with the BlueSCSI device. ◆

[@europlus: #MARCHintosh \[2024\] Wrap Up, GlobalTalk News](#)

Includes instructions for setting up bridged networking for QEMU on Ubuntu for GlobalTalk access. Check out the GlobalTalk tag on the site for related articles.

[@1Bit: Guide to get the QEMU emulator to work with GlobalTalk in Win11](#)

1Bit's guide takes GlobalTalk node admins looking to use QEMU under Windows 11 for their Apple Internet Router system through setting up the necessary emulation files and networking.

[@fozztexx: QEMU+Apple Internet Router docker setup](#)

FoZZTexx reverse engineered the location of relevant data on QEMU disk images to configure QEMU from a Python script while spinning up a QEMU Docker instance!

[@Autumn: Setup Guide: VNC-enabled QEMU Apple Internet Router bridged host on non-GUI Debian 12](#)

This is how Autumn virtualised their GlobalTalk router to run as a VM on a headless Debian server

[classicvirtio](#)

An extension for QEMU which emulates a NuBus card enabling a tablet device (for making cursor movement in QEMU much smoother/sensible), a virtual shared folder from the host system, and an ability to read disk image files which do not have partitioning information (such as Basilisk II and Mini vMac disk images).

- ◆ **Note** classicvirtio requires QEMU v9.0 or later, or a patched version of QEMU v8.x. ◆

[UTM](#) (simple QEMU on macOS) and [utmconfigs](#) (pre-rolled UTM configurations)

UTM is a GUI skin for QEMU which runs on macOS. It makes setting up virtualised or emulated systems very easy, and surfaces common QEMU settings, while allowing some of the advanced command line options and switches to be set manually.

I use UTM for my PPC Mac OS 9.2.2 system, and I used a config file from utmconfigs to create my emulated Mac OS X v10.3 client machine to test AppleTalk access in Mac OS X, and another as the basis for the UTM package in my [GlobalTalk Setup Files](#) package.

The Mac OS 9.2.2 and Mac OS X v10.3 emulated systems both see GlobalTalk nodes and resources/devices as native network members via bridged Ethernet networking (see section “[Bridged vs NAT networking for emulated systems](#)” later in this chapter).

- ◆ **Note** UTM does not always have the current or stock version of QEMU within it, and extensions may not be included (for example, classicvirtio only works in PowerPC emulated systems, and only PCI interfaces are presented to the Quadra 800 emulation). ◆
- ◆ **Note** Installer disk images are not provided with these configuration files, and it is left as an exercise for the reader to image their own media appropriately for use with them. ◆

Other emulation systems

It is possible to use other emulators on GlobalTalk. Some suggested resources follow.

Basilisk II

Some administrators have successfully configured the Basilisk emulator to act as Apple Internet Router nodes and GlobalTalk client machines. A review of the GlobalTalk coordinating Google Sheet will allow administrators who wish to do the same to discuss such configuration with administrators who have successfully used such a configuration.

Mini vMac

Similarly, Mini vMac has had several appearances on GlobalTalk, sometimes utilising a TashTalk or TashRouter configuration. A review of the GlobalTalk coordinating Google Sheet will allow administrators who wish to do the same to discuss such configuration with administrators who have successfully used such a configuration.

[@mejs: Using TashTalk With Mini VMac To Participate In #GlobalTalk](#)

Vlado discusses some of the intricacies of the TashTalk hardware/software combo to allow LItoUDP-aware applications and devices on modern networks to see LocalTalk traffic via a transceiver attached to the TashTalk (see discussion of the TashTalk and TashRouter in the “[Modern solutions](#)” section in this chapter).

Connecting to Ethernet

Built-in, expansion cards, BlueSCSI WiFi

Your Apple Internet Router host will need an Ethernet connection, either built-in or via an expansion card. I have even seen mention that a BlueSCSI's Dayna SCSI Ethernet emulation (via WiFi) can also act as an Apple Internet Router host's Ethernet port for EtherTalk and IP Tunnelling.

◆ **Note AAUI vs RJ45:** If your built-in or expansion card Ethernet has an AAUI (Apple Attachment Unit Interface) port, you'll need an AAUI Transceiver to convert to the RJ45 used on most Ethernet equipment these days. These are available from, for example, eBay for as little as USD\$15 (plus shipping). Make sure you get an AAUI to RJ45 transceiver! The BNC/Thin Ethernet adaptors will not allow you to connect to modern network routers and switches! ◆

Network speed considerations

A consideration when connecting equipment as old as that which runs Apple Internet Router (or older Mac OS versions) is that they will often struggle with auto-negotiation of Ethernet speeds (10/100/1000mb/s).

You can, however, use a slower switch or hub to connect to your main network, and then connect your retro-Macintoshes to that slower switch/hub. A 100mb/s switch/hub is likely to be a reasonable bridge between older devices and newer networks if your retro-Macintoshes are struggling.

I leave it as an exercise for the reader to locate such older networking equipment, and to understand the difference between a switch and a hub—that difference should not be

important when connecting to GlobalTalk, but switches may be better at auto-negotiation than 10mb/s hubs.

Bridged vs NAT networking for emulated systems

Emulated systems will be connecting via emulated Ethernet ports, and the network speed considerations mentioned above will not come into play.

But such emulated Ethernet ports do have a few issues which need to be addressed.

Firstly, most WiFi adaptors in emulator host systems will not transport AppleTalk traffic. This means the emulated system's Ethernet port will need to be “hard”-attached to an Ethernet port on the host system.

Emulation systems use a variety of methods to transport packets between the emulated Ethernet port and the “real” network.

One such method is that the host provides a NAT (Network Address Translation) virtual network—similar to an internet router offering NAT to its internal network.

Another method is “host-only” networking, where the emulated OS can only network to the host OS.

However, best results for emulated GlobalTalk Apple Internet Router nodes and client systems will be achieved using “Bridged Networking”, where the emulated Ethernet port is presented to the physical network by the host system as if it were a distinct physical port.

This allows the full routing of all Ethernet traffic from the emulated system to the physical network and vice versa.

The number of emulation systems and the number of host operating systems they operate under makes it infeasible to provide Bridged Networking examples here.

Some systems, such as UTM, provide a simple interface to select such a setup.

Others, such as QEMU running on Linux systems, will require setup and resultant initiating commands unique to the Linux system and emulator being used.

GlobalTalk node administrators have worked through, and sometimes documented, many of the system combinations which are used on the GlobalTalk network, so reach out to your fellow administrators using the #GlobalTalk hashtag (or by reviewing the GlobalTalk coordinating Google Sheet) with details of the emulation system (and version) and host operating system (Linux, Windows, macOS) and version you intend to use to see if you can get specific advice (see also the “[Real vs emulated hardware](#)” earlier in this chapter for some links to guides for emulator-based systems).

Network numbering and zones

As detailed in section “Identifying networks on an internet” in Chapter 4, network numbers defined by Apple Internet Router nodes on an AppleTalk internet must not overlap or conflict with other network numbers or ranges on the AppleTalk internet.

Under the Phase 2 AppleTalk protocols Apple Internet Router uses, a single network number can accommodate 253 connected devices, so it acts much like the “/24” net mask in IP.

Valid network numbers range from 1–65,279.

At 253 devices per network number, that’s 16,515,587 possible GlobalTalk devices!

Most GlobalTalk networks and segments will be much smaller than their theoretical maximum, so it will always be much smaller than that.

LocalTalk vs EtherTalk network numbers

LocalTalk networks, usually connected via the Modem and/or Printer port in older Macs, need to have a unique network number assigned via Apple Internet Router.

EtherTalk networks are assigned a range of network numbers to accommodate the larger number of devices these networks support.

Network ranges

Although Ethernet networks are generally larger than LocalTalk ones, it is unlikely that any single EtherTalk segment on GlobalTalk will exceed 253 devices. In this case, a range of a single number, such as “65279–65279” would be adequate.

More complex configurations, especially those with third party hardware or software AppleTalk router/bridge devices in the mix, or separate Ethernet segments being accessed by a single Apple Internet Router host, will need additional numbers in the range Apple Internet Router is configured with.

Claiming network numbers and ranges on GlobalTalk

It is suggested that in the first instance, absent any complications in configurations and network equipment being likely to be used, a single number range, not currently claimed on the GlobalTalk coordinating Google Sheet, be selected by administrators for their EtherTalk segment.

A unique number (which does not have to be adjacent to the EtherTalk range, but should also not be *inside* that range) will need to be claimed for each LocalTalk segment you are adding to Apple Internet Router.

If you have multiple locations, or a complicated configuration which cannot be expressed as a simple range, multiple lines in the spreadsheet should be created for each location or for each range being claimed (even if a single number range).

This makes it easier for other administrators to understand which numbers and ranges have already been claimed and to avoid conflicts.

When ranges overlap

Across an AppleTalk internet like GlobalTalk, these ranges and network numbers cannot overlap across Apple Internet Router nodes and the networks they route/bridge. If Apple Internet Router nodes see such overlap, they will usually only show the networks connected to the first Apple Internet Router node which it becomes aware of.

AppleTalk zones

AppleTalk networks could be divided into zones, effectively labels for similar types, or locations/departments, of devices.

For example, a large organisation may have had “Marketing”, “Engineering”, “Accounts”, “Manufacturing”, and “Administration” zones established to allow computers in a zone to more easily navigate to peripherals such as printers in their department in the Chooser interface.

Splitting a network in a zone still allows full navigation of all devices visible on the network, but in a categorised fashion to aid quick navigation.

Of course, zones could also designate geographical, or even floor-level, locations, or more abstract designations such as “Printers” if that were deemed suitable by the network administrators.

Zones can cross ports—i.e. a single zone (or multiple zones) can be applied to both the LocalTalk and EtherTalk ports in Apple Internet Router to simplify the logical configuration of the network.

Most GlobalTalk administrators will likely be satisfied with one zone, or perhaps one zone per port, but should keep in mind the possibilities zones allow for easing navigation on more complicated configurations or networks.

CGNAT and Tier 1 VPNs

As discussed above, most internet routers in the 21st Century utilise Network Address Translation (NAT) to share a single external (a.k.a. WAN, wide area network) IP address with multiple devices on the internal network (a.k.a. LAN, local area network) sharing that external IP address.

This external IP address may or may not be “publicly-routable” (i.e. the device can be directly connected to at that address by devices outside the device’s internal network).

However, due to the risks of IPv4 address exhaustion, some carriers/ISPs now utilise “Carrier-Grade NAT” (CGNAT), whereby NAT is extended further out on the ISP’s network, and the external IP address of a local network’s router may no longer be publicly-routable.

If you are able to review your Internet router’s settings, and you can see that the network router’s external IP address is in the range 100.64.0.0–100.127.255.255, your ISP is utilising CGNAT.

If your network router has an external IP address within any of the other reserved private network IP address ranges¹, your ISP is using “plain old NAT”.

Either way, this imposes some limitations on your Apple Internet Router node.

There is not a hard *requirement* for a publicly-routable address in Apple Internet Router to establish outbound connection to other Apple Internet Router nodes.

However, any new nodes, or any restarted nodes, will not be able to communicate with your node until *your* node restarts and re-establishes the link via an outgoing connection.

Robust connections between nodes, independent of any downtime of the nodes involved, requires a publicly-routable IP address and port forwarding (see “[Port forwarding](#)” section below).

Some administrators have utilised Tier 1 VPNs to get around this limitation, but it is beyond the scope of this document to detail how this is achieved.

¹IP address ranges reserved for private use are: 10.0.0.0–10.255.255.255; 172.16.0.0–172.31.255.255; and 192.168.0.0–192.168.255.255

NAT hairpinning

NAT hairpinning (a.k.a. “NAT loopback” or “NAT reflection”) allows devices in a network router’s *internal* network to address the router via its *external* IP address.

This is most useful when wanting to access an internal service (usually via port forwarding) from one device inside the network using the same connection settings as an external device would use.

NAT hairpinning use cases include:

- Setting up a device which may access services from both inside and outside the network (e.g. a laptop which may be used externally to the network).
- To simplify set up instructions or troubleshooting by having all devices internally and externally use the same connection settings

Network router configuration

DHCP and DHCP reservation vs manual address

Dynamic Host Configuration Protocol (DHCP) is utilised by most network routers to auto-configure devices on its internal network (including the allocation of an IP address).

Most network routers allow DHCP reservations to be configured so that a device always gets the same network configuration. Most DHCP implementations utilise the client device’s Ethernet Media Access Control (MAC, not “Mac”, though it’s pronounced that way) address, which is usually expressed as 6 hexadecimal bytes separated by colons.

Ideally, an IP address for the Apple Internet Router node should be selected from outside the DHCP range, as MacTCP does not support DHCP for automatic configuration.

If that’s not possible, you may still want to configure the network router with a DHCP reservation for the AppleTalk router device’s MAC address to prevent other network devices receiving that address via DHCP.

In either case, you will need to manually configure the IP address in [MacTCP](#) on the Apple Internet Router host.

◆ **Note** When utilising emulated client devices on any modern network it is critical to ensure each emulated device has a unique MAC address defined in the emulated system’s configuration to ensure proper and reliable routing of network packets to all devices, both emulated and real. ◆

It is left to the node administrator to determine the best utilisation of DHCP and manual address assignment.

IP address vs hostname

The Domain Name System (DNS) is the way the underlying numeric IP addresses of devices on a TCP/IP network are mapped to “human friendly” domain names to aid connections. For example, “apple.com” is easier to remember and use/enter than “17.253.144.10”.

DNS also allows the same domain name to be available via different IP addresses over time as infrastructure changes, or even for multiple IP addresses to be allocated to distribute traffic to a single domain name (it is also possible to assign multiple domain names to single IP addresses, which can aid servers to distinguish traffic for different services).

Node administrators may wish to utilise domain names in the GlobalTalk coordinating Google Sheet as they are easier to enter/remember, but other nodes’ addresses are usually only entered once, so for static external IP addresses, this is not necessarily a large benefit.

For nodes where the external address changes, via new DHCP leases, a Dynamic DNS service may be of use.

Dynamic DNS

“Dynamic DNS” services accommodate a local network’s external IP address changes via new DHCP leases, and can also be useful when a node administrator has not registered a personal domain name for their network as they can act as a cheap/free pseudo-registrar for external IP addresses not assigned to a hostname.

A Dynamic DNS setup allows the IP address assigned to a domain name to be updated by a device on the internal network (usually the network router), whenever that device registers a change in the network’s external IP address. While not instantaneous, this usually allows uninterrupted access to the network via the domain name.

Cheap (often free) Dynamic DNS services are available, and many domain registrars now allow dynamic updates of their DNS records via Dynamic DNS as a network router’s external IP addresses change.

Port forwarding

Ports are labels assigned to network packets which allow the efficient routing of different types of network traffic.

Usually indicated as a number after an IP address or domain name and a colon (e.g. “apple.com:443” for HTTPS traffic to the domain name “apple.com”), ports can help network routers to forward packets to the appropriate internal devices via a method unsurprisingly called “port forwarding”.

◆ **Note** Each port can only be forwarded to one internal host—the router has no way of choosing between internal hosts for any given packet to a given port, so should only allow one “port mapping” per port (definition of which host gets which port). ◆

Ports have an associated protocol (such as TCP or UDP)—while beyond the scope of this chapter to describe the differences in detail, these protocols have differing features in relation to, for example, whether traffic is assured of delivery or not (or flagged as timed out if delivery is unsuccessful).

To ensure the reliable connection between Apple Internet Router nodes, each administrator should forward UDP port 387 (officially defined as AURP, the AppleTalk Update-based Routing Protocol) to the internal/local IP address of their Apple Internet Router node. This allows other nodes to establish/re-establish connections when they restart, rather than relying on outbound connections upon local Apple Internet Router node restart only (those outbound connections will only succeed when the node being connected to also has UDP port 387 forwarded in this way).

GlobalTalk software set up

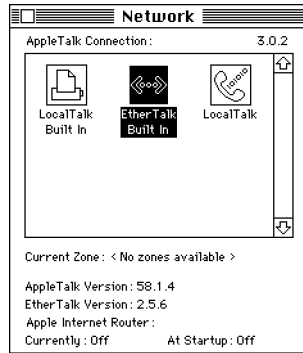
Network services configuration

While not intended to provide all details, the following are the broad brushstrokes steps needed to get a Classic Mac running System 7.1 configured as a basic GlobalTalk node router.

- ◆ **Note** These instructions assume you have:
 - a publicly-routable external IP address
 - your network router configured with UDP port 387 forwarded to your intended Apple Internet Router host's internal IP address
 - no conflict of that IP address with any other devices on the local network
 - a Classic Macintosh, real or virtual, running System 7.1 and connected to an Ethernet network (LocalTalk is optional)
 - Apple Internet Router installed (see section “Installing the router on a startup disk” of Chapter 2)
 - The Apple Internet Router AppleTalk/IP Wide Area Extension installed
 - MacTCP Ping installed

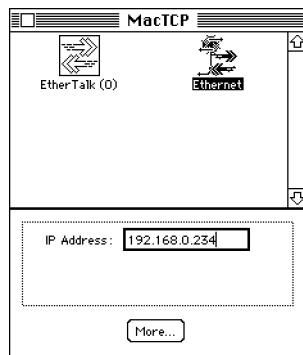
All the necessary software installers are located in the GlobalTalk Installers folder in the “Sys7.1-GlobalTalk_Install.img” disk image and the “GlobalTalk HD.img” has all the necessary components pre-installed—these disk image are part of [@europlus' GlobalTalk Setup Files](#). ◆

- 1 Start your Apple Internet Router Macintosh and open the Network control panel and make sure EtherTalk is selected.



◆ **Note** If you are using an expansion card or BlueSCSI, you will need to make sure you choose the Ethernet port which represents that device. ◆

- 2 Open the MacTCP control panel.
- 3 Select Ethernet as the port, then enter the IP address you wish to use for the Apple Internet Router Macintosh .



- 4 Click More....
- 5 Select Manually as the Obtain Address method.
- 6 Enter your network router's internal IP address as the Gateway Address.
- 7 Do not worry about the settings for network classes or subnets.

- 8 Enter a full stop (a.k.a. dot, period, CHR\$(46), ASCII 0x2E) in the Domain Name Server Information first line's Domain field, then enter you primary DNS server's IP address in that same line's IP Address and select Default on that line.

The screenshot shows the MacTCP control panel with the following settings:

- Obtain Address:** Manually (selected), Server, Dynamically.
- Routing Information:** Gateway Address: 192.168.0.1.
- IP Address:** Class: C, Address: 192.168.0.234, Subnet Mask: 255.255.255.0.
- Domain Name Server Information:** A table with columns Domain, IP Address, and Default. The first row has a period in the Domain field, 192.168.0.1 in the IP Address field, and the Default radio button selected.

◆ **Note** You can enter additional DNS servers, but anything which is a DNS server for a search domain should have the search domain terminated by a full stop in the Domain field. For most scenarios a single DNS server's IP address (usually the network router's internal IP address) is sufficient if configured in this way. ◆

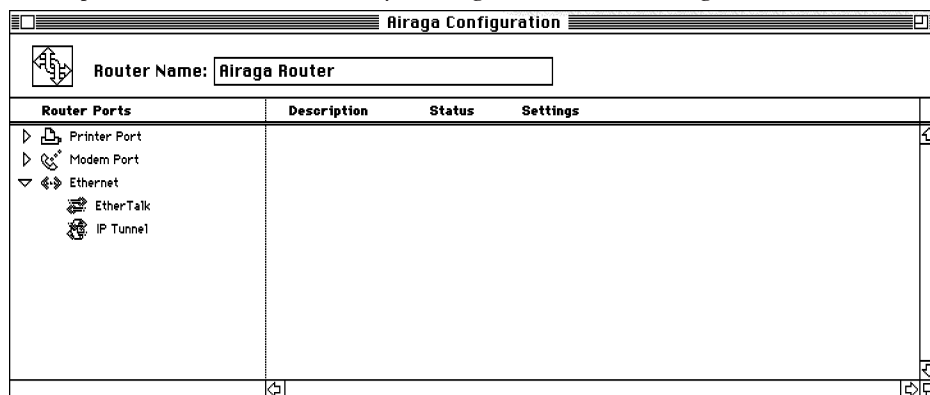
- 9 Click OK (or press Enter) then close the MacTCP control panel. It is best to restart your Apple Internet Router Macintosh at this point.
- 10 Open MacTCP Ping and attempt to ping your network router's internal IP address ("192.168.0.1" in the graphics shown), then some external addresses (e.g. an external DNS server). You should be able to ping both IP addresses and hostnames. If successful, you're now ready to move onto configuring the Apple Internet Router components.

The screenshot shows the MacTCP Ping Information window with the following settings and results:

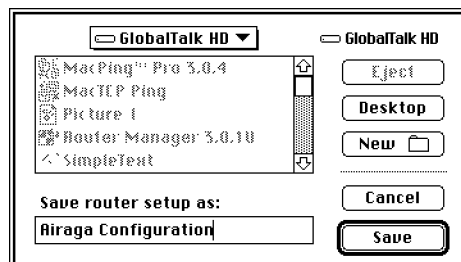
- Ping Host Address:** 192.168.0.1
- Send:** ASCII data
- Packet Data Size:** 56 bytes, Send: 1 packets
- Send a packet every:** 60 ticks, Send continuously (unselected)
- Display:** All Data (selected), Summary Data (unselected)
- Results:**
 - Packets out/in/bad/loss = 1/1/0/0
 - Round Trip Time (Ticks) min/avg/max = 1/1/1
 - Source: [192.168.0.234] --> Destination: [192.168.0.1]
 - Table with columns: RESULT, PKT#, TIME, LENGTH. Row 1: success, 1, 0, 56.
 - Packets out/in/bad/loss = 1/1/0/0
 - Round Trip Time (Ticks) min/avg/max = 0/0/0

Apple Internet Router setup—a walkthrough

- 1 Open Router Manager and widen the Configuration window, enter a name for your router, and expand the Ethernet section by clicking the disclosure triangle:



- 2 Choose Save from the File menu, then give your configuration file a name, and choose a location (in the same folder as Router Manager is probably best):



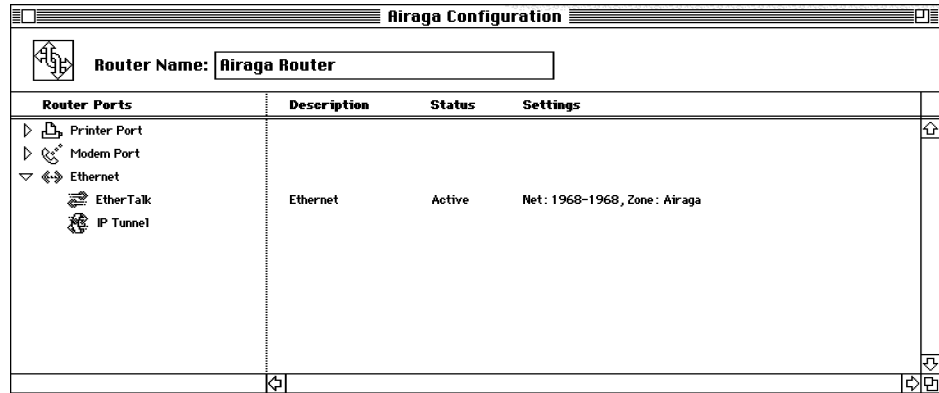
- 3 Double click on the “EtherTalk” item under “Ethernet”, set the “Port:” radio button to “Seed”, enter the single number network range you selected and entered on the coordination Google Sheet in the two “Network Range:” fields, enter your chosen EtherTalk zone name in the “Zone Name:” field and click Add—your Port Info window should now look something like this:

Click Define (or press Return or Enter).

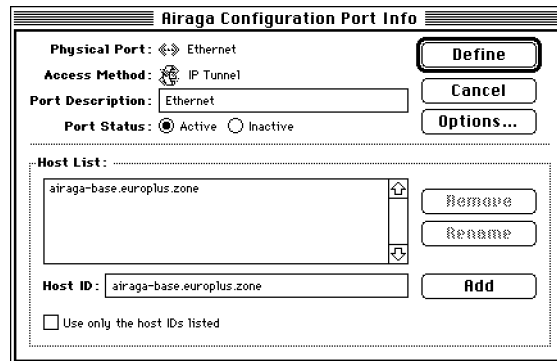
◆ **Note** “Seed” is the setting which makes the router software define itself as the controller of the AppleTalk network for this segment—only one seed router can be present on any single segment. If the router is going to be routing for any LocalTalk (or other) segments, it should have “Seed” selected for those ports, too. Nonseed routers get their configuration from seed routers, and would generally be on a more complex network configuration beyond the scope of the chapter to discuss. If unsure, selecting “Seed” is the safe option. ◆

◆ **Note** A zone name is not restricted to one port or segment. while devices may be separated across networks or ports on an individual Apple Internet Router, **all** devices on the same zone, no matter which segment they are connected to, will appear together in the Chooser. ◆

4 Your Configuration window should now look something like this:

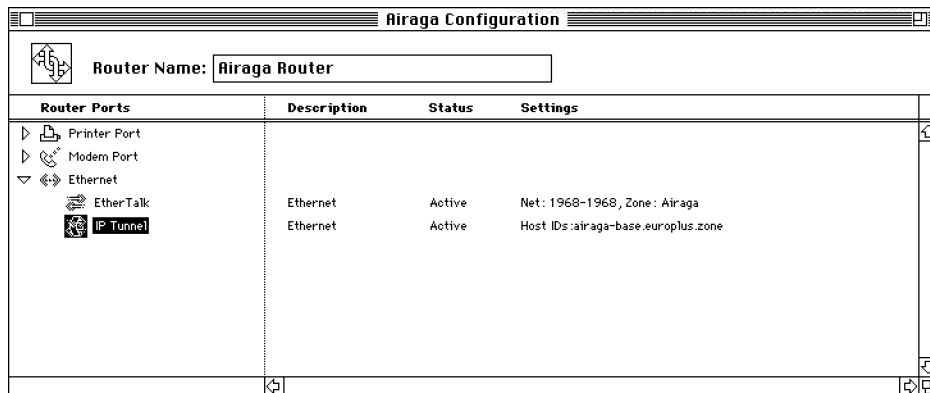


5 Double-click the "IP Tunnel" listing under "Ethernet", uncheck the "Use only the host IDs listed" checkbox, enter a "Host ID:" of "airaga-base.europlus.zone" and click "Add"—your Port Info window should now look something like this:



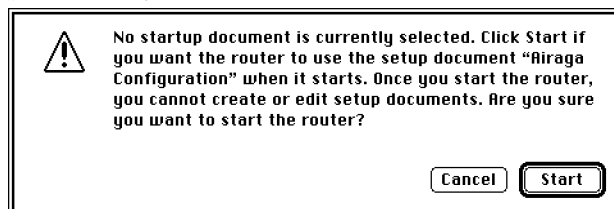
Click Define (or press Return or Enter), then Save (⌘-S).

6 Your Configuration window should now look something like this:

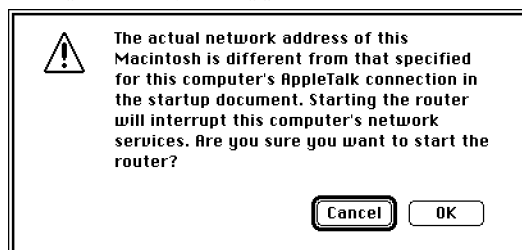


7 You're now ready to test your setup! Choose "Start Router..." from the Control menu. If you're using the [@europius](#)-supplied disk images (see "QEMU" section in this chapter), -U will start and stop the router.

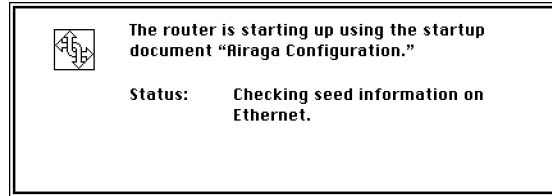
8 You will see a message about no startup document being selected—just click Start (or press Return).



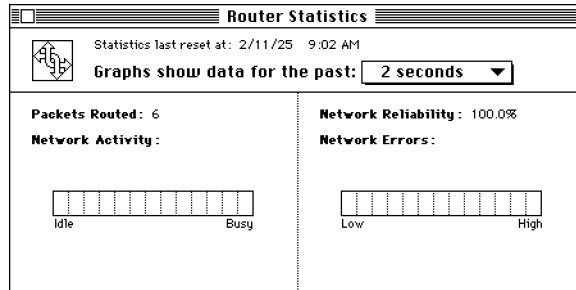
9 If your computer had a network number automatically assigned by the AppleTalk subsystem, you may see a message about the actual network address being different to that specified by the AppleTalk connection—just click OK.



- 10 The router should then cycle through several messages while it configures system components and connects to the network.



- 11 If you successfully connect to the airaga-base node, you will see a Router Statistics window appear, and the Network Information will show two networks, one of them being the Airaga zone on network number 19680—this means you have successfully connected to the airaga-base node!



Network Information

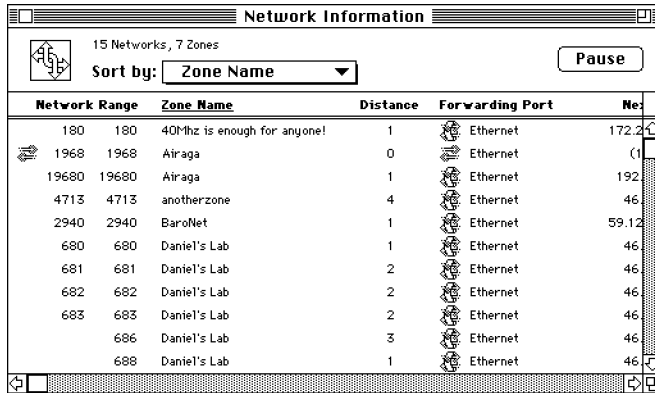
2 Networks, 1 Zone

Sort by: Zone Name

Pause

Network Range	Zone Name	Distance	Forwarding Port	Net
1968 1968	Airaga	0	Ethernet	(1)
19680 19680	Airaga	1	Ethernet	192

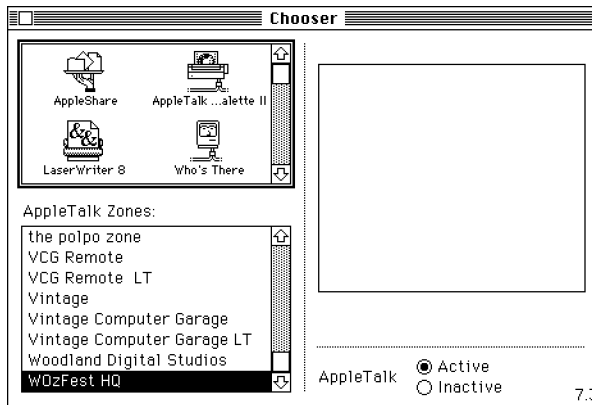
- 12 If you see other networks appear, they are being routed via the airaga-base node from other nodes which have connected to airaga-base.



The screenshot shows the 'Network Information' window with a title bar and standard Mac OS window controls. Below the title bar, it says '15 Networks, 7 Zones'. There is a 'Sort by:' dropdown menu set to 'Zone Name' and a 'Pause' button. The main area contains a table with the following columns: 'Network Range', 'Zone Name', 'Distance', 'Forwarding Port', and 'Net'. The table lists various networks and zones, including '40Mhz is enough for anyone!', 'Airaga', 'anotherzone', 'BaroNet', and 'Daniel's Lab'. Each row shows the network range, the zone name, the distance, the forwarding port, and the network number.

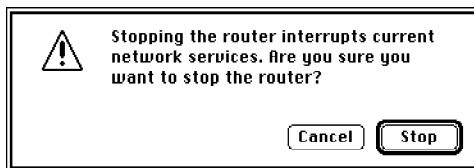
Network Range	Zone Name	Distance	Forwarding Port	Net
180 180	40Mhz is enough for anyone!	1	Ethernet	172.2
1968 1968	Airaga	0	Ethernet	(1)
19680 19680	Airaga	1	Ethernet	192
4713 4713	anotherzone	4	Ethernet	46
2940 2940	BaroNet	1	Ethernet	59.12
680 680	Daniel's Lab	1	Ethernet	46
681 681	Daniel's Lab	2	Ethernet	46
682 682	Daniel's Lab	2	Ethernet	46
683 683	Daniel's Lab	2	Ethernet	46
686 686	Daniel's Lab	3	Ethernet	46
688 688	Daniel's Lab	1	Ethernet	46

- 13 You should see the zone-aware Chooser window now, with the small pane at bottom left to choose a zone from. If only the airaga-base node has connected, you will only see your own zone and the “Airaga” zone. Feel free to explore the Airaga zone.



◆ **Tip** Remove any Chooser extensions you don't need from the Extensions folder in the System folder to reduce the need to scroll down the list of Chooser extension. For example, if LaserWriter 8 is installed, remove LaserWriter, and if using the MacPalette driver, remove the AppleTalk ImageWriter extension. ◆

- 14 When you need to change the configuration, you'll need to stop your router before any changes are possible. Choose “Stop Router...” from the Control menu (⌘-U), and confirm the stopping of the router.



- 15 You're now ready to add further Host IDs from the coordination Google Sheet—repeat the addition as shown in Step 5 with the hosts from the Sheet, or use [AirConfig](#) (with [GlobalTalk Updater](#)) to speed this process up and avoid transcription errors.
- 16 Start the router again and confirm you see more nodes—you're now ready to explore the wider GlobalTalk internet!

GlobalTalk troubleshooting basics

A comprehensive troubleshooting guide is beyond the scope of this chapter, especially due to the complex differences between running on real vs emulated hardware. Here are general notes to point GlobalTalk administrators in the right direction, or provide test data which will help to solve the problem in consultation with other GlobalTalk administrators.

When referenced, tools are cross-linked to their entry later in the “[Useful utilities and resources](#)” section in this chapter.

TCP, UDP and IP issues

Given the GlobalTalk network is made up of nodes connected via the IP Tunnel component of Apple Internet Router, getting these network protocols right is critical.

Some things to check are:

- Make sure you have correctly set up the details in MacTCP—this can be checked by using [MacTCP Ping](#) to ping your router, the IP address of an external server (such as Google’s DNS server at “8.8.8.8”, and external addresses at their domain name (for example, “www.apple.com”).
- Use a program such as Fetch (FTP client) to check that connections to external resources can be established and utilised by the AppleTalk router Macintosh.
- Use a program such as MacHTTP (HTTP server) installed on the AppleTalk router Macintosh to check that incoming connections can be established to the AppleTalk router Macintosh (be sure to forward port 80 to that Macintosh as needed).

◆ **Note** Fetch and MacHTTP are available on the “Sys7.1-GlobalTalk_Install.img” disk image, part of [@europlus’ GlobalTalk Setup Files](#). ◆

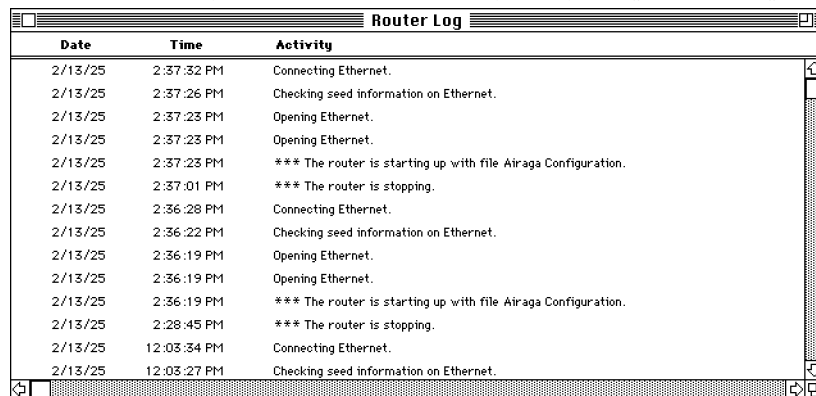
- Check that your network router correctly forwards UDP port 387 to your Apple Internet Router machine—if you see other routers when you start Apple Internet Router, but other administrators advise you they can’t see your AppleTalk router when they restart theirs, incorrect port forwarding settings are most likely to blame.
- If you are using emulated hardware, testing TCP, UDP and IP issues becomes significantly more challenging. With the extra layer of abstraction, there are numerous ways the required settings can be slightly misconfigured and stop the whole system from working. Being prepared to spend significant time with frustrating troubleshooting is essential. If following guides, double and triple check the instructions have been followed correctly.

AppleTalk issues

The most common AppleTalk issue will be conflicting network numbers or ranges. Double check the coordinating Google Sheet, and try a different number or range in case the conflicting range is not documented.

Reference should be made to Chapter 10, Troubleshooting, which includes potential causes for many error messages or problems when running Apple Internet Router.

The Router Log available in Router Manager may also point to the problem:



Router Log		
Date	Time	Activity
2/13/25	2:37:32 PM	Connecting Ethernet.
2/13/25	2:37:26 PM	Checking seed information on Ethernet.
2/13/25	2:37:23 PM	Opening Ethernet.
2/13/25	2:37:23 PM	Opening Ethernet.
2/13/25	2:37:23 PM	*** The router is starting up with file Airaga Configuration.
2/13/25	2:37:01 PM	*** The router is stopping.
2/13/25	2:36:28 PM	Connecting Ethernet.
2/13/25	2:36:22 PM	Checking seed information on Ethernet.
2/13/25	2:36:19 PM	Opening Ethernet.
2/13/25	2:36:19 PM	Opening Ethernet.
2/13/25	2:36:19 PM	*** The router is starting up with file Airaga Configuration.
2/13/25	2:28:45 PM	*** The router is stopping.
2/13/25	12:03:34 PM	Connecting Ethernet.
2/13/25	12:03:27 PM	Checking seed information on Ethernet.

◆ **Note** [MacPing Pro](#) can help with exploring and troubleshooting AppleTalk networks, as can just exploring zones and devices via the Chooser (especially with [Who's There](#) installed). [Trawl](#) can also aid in visualising the GlobalTalk internet. ◆

System issues

There are numerous possible causes of System-level issues, but the following general recommendations will at least reduce potential conflicts and reduce startup times, thereby making troubleshooting a more straightforward exercise:

- Reduce the number of Extensions (including Chooser extensions) and Control Panels to only those needed to run Apple Internet Router. For example, the base System 7.1 install will have an “Apple CD Speed Switch” control panel, and Chooser extensions such as “Personal LaserWriter SC”, which will almost certainly not be needed.
- Check the amount of free RAM on startup to ensure the Macintosh is not low on RAM.
- Change the display settings in the Monitors control panel—setting to Black and White will reduce load on your machine, especially if emulated.

Backing up

Now is a good time to consider backing up your configuration—whether by shutting down an emulated machine and making copies of the image file of the Apple Internet Router node boot disk, or by copying the boot disk's setup files over the network, or using contemporaneous backup solutions or compression programs.

Additionally, consideration should be given to any other relevant files you may wish to backup, such as emulation host system configuration files, and file share contents.

Periodic backing up of files will ensure recovery from any disaster has limited impact.

GlobalTalk network services

Any AppleTalk-compatible services are able to be run on the GlobalTalk network, and AppleTalk-capable clients will be able to see them as valid network devices, usually by navigating zones for each network type.

Selecting a server will depend on the service—some, such as file sharing, are selected in the Chooser via Chooser extensions. Others are selected within a client application.

Here we will look at some of the most common services, and mention a few of the less common ones you may encounter when navigating the GlobalTalk network.

File sharing

Many GlobalTalk node administrators have made available files they think others might be interested in via file sharing servers.

Additionally, “drop boxes” have also been created—these are like a “visitor’s book”, where files such as postcards, messages, or other mementos, can be left. There are many creative files which were left in drop boxes during MARCHintosh 2024 celebrating that event and the establishment of the GlobalTalk network.

While it is beyond the scope of this chapter to detail how to set up file sharing services, below are the most common server types on GlobalTalk.

AppleShare

Perhaps the simplest file share server to setup, AppleShare is built-in to the Mac OS versions which run and access GlobalTalk.

Netatalk

Netatalk is free and open source software which runs on many OSes and provides access to Apple-centric file and print sharing services.

Netatalk 4’s release in late 2024 saw the return of native AppleTalk support to the package, which was not present in v3.

Netatalk is the most common way to provide AppleShare services from Linux operating systems.

Other file servers

Other AppleTalk-compatible file sharing solutions have also been on GlobalTalk—in fact, a Windows NT file server with the appropriate AppleTalk-related extensions appeared on GlobalTalk during MARCHintosh 2024.

Users and permissions

Usually, visitors connect as the “Guest” user with no password and have read-only access to the files the administrator wishes to share, and read/write (or perhaps write-only) access to drop boxes.

Printing

One of the features of AppleTalk was easy print sharing, and this flows through to GlobalTalk.

There are a plethora of printers on GlobalTalk, including original, modern and virtual printers. They come in several flavours, but the most common ones are described here.

LocalTalk printers

Many inkjet and dot matrix printers were either AppleTalk compatible or able to be made so with LocalTalk adaptors.

◆ **Note** There are software solutions to bridge serial printers to LocalTalk via the Macintosh they are connected to. Look for Printer Share, GrayShare and ColorShare—additionally, the driver for the LaserWriter 300 series printer had the same capability. ◆

Administrators around the world have made black and white and colour printers available for other GlobalTalk users to print to.

MacPalette II driver

For ImageWriter II printers with colour ribbons, the MacPalette II driver gives superior results to Apple’s own drivers.

Laser printers and PPDs

Many laser printers have been able to be connected to LocalTalk or EtherTalk networks, and there are many laser printers available to print to on GlobalTalk. Some are modern colour printers.

Best results are achieved with Postscript-capable printers in conjunction with the LaserWriter and LaserWriter 8 printer drivers, and, if available, use the PPDs (Postscript Printer Description files) some administrators have been able to supply for their printers, which allow printer-specific options (such as duplex [double-sided] printing).

Printing to PDF

Some administrators have set up “Print to PDF” printers, which output directly to PDF files, which are often then available to download. This allows vintage software to output to PDF for viewing on modern OSes.

Most often, these printers are available in the LaserWriter and LaserWriter 8 printer drivers shown in the Chooser.

CUPS and Netatalk

Many of the available modern and virtual printers on GlobalTalk are set up via the Common Unix Printing System (CUPS) and Netatalk. Some of the modern printers include peculiar devices such as thermal receipt printers—usually these are connected via CUPS and Netatalk, and perhaps some bespoke scripting components.

Set up is reasonably complex, but the fact modern printers and file output can be provided to vintage systems can make it well worth the effort.

◆ **Note** Please keep in mind many of these printers are old, and even if dot matrix ribbons and inkjet cartridges are new-old-stock (NOS) or newly manufactured equivalents, they are often not cheap to replace. Please be considerate when printing to any kind of printer and keep it to a small number of pages (perhaps one, at least without checking with the node administrator first). ◆

Other services

Gaming

AppleTalk-aware games are able to be played over GlobalTalk—keep in mind the latency of gaming over the internet. Bolo and Spectre servers have been set up, and it’s hoped that more games will be played over the worldwide network in coming MARCHintoshes.

PowerTalk and AppleMail

System 7.1.1 (a.k.a. System 7.1 Pro) included PowerTalk, a collaborative technology system which included AppleMail, a basic mail system for AppleTalk networks. AppleMail features stationery/templates for messages, and addressing is very simple, with auto-discovery of servers and accounts.

◆ **Note** A System 7.1.1 installer is on the “Sys7.1 + GlobalTalk Installers” drive image which is part of [@europlus’ GlobalTalk Setup Files](#) archive. ◆

If you install System 7.1 Pro, look around for other AppleMail servers and drop the administrator there a short note.

AppleMail was short-lived, but PowerTalk in System 7.1 Pro saw the first appearance of keychain technology in Mac OS (called the PowerTalk Key Chain). The keychain concept remains in Apple OSes this day, still available in macOS Sequoia under that name, but also in a more user friendly interface through the newly released Passwords app available in macOS, and iOS/iPadOS.

BBSes, forums and chat

Relatively under-utilised, more social communication services during MARCHintosh 2024 were limited primarily to a bespoke HyperCard stack by [@kalleboo](#) called GlobalTalk Chat, which allowed chat sessions between users across GlobalTalk ([@kalleboo](#) also released a Zone Watcher stack, a Hypercard “web” style stack in which pages could be created, and Apple Internet RouterConfig (see below).

EZChat is a multi-zone aware chat program and server developed in the 1990’s for System 6 and 7 Macintoshes.

In early 2025, a TeleFinder BBS system was put on GlobalTalk, and it’s hoped more such BBS/discussion forum servers will appear on GlobalTalk over time to facilitate communication on the network.

Network backups

A Retrospect network backup server surfaced during MARCHintosh 2024. Retrospect was a major player in Mac OS backup in the 1990s, and its network backup capabilities were critical to protecting many networks. With scheduled and rolling backups, its capabilities were extensive, and well worth a play with to see how backup was done before Time Machine.

MacIP Gateway

The MacIP Gateway service which is part of Netatalk allows AppleTalk-connected computers to access the Internet (or TCP/IP services generally) routed through the AppleTalk network.

This allows older Macs without Ethernet ports to access internet services such as web, FTP and gopher sites.

Useful utilities and resources

There are, of course, numerous utilities and apps which make using Classic Mac OS more enjoyable, but those listed below have particular uses on Apple Internet Router nodes and AppleTalk clients.

Most will run on older Mac OSes except where noted.

◆ **Note** While a location on the GlobalTalk network is often provided here, the programs which run under the Classic Mac OS (indicated with a small Apple logo—) are located in the Apps folder in the “Sys7.1-GlobalTalk_Install.img” disk image—this disk image is part of [@europlus’ GlobalTalk Setup Files](#). ◆

◆ **Note** The afp:/ URLs used below follow this format, most often used in Mac OS X:
afp:/at/ServerName:Zone/Share/Path/
Some clients will not navigate past the Share component of such URLs. ◆

Router Manager 3.0.1W

A modified version of the Router Manager application, which has additional key commands:

Command	Shortcut
Start Router...	⌘-U
Stop Router...	⌘-U
Set Startup...	⌘-B
Reset Statistics...	⌘-R
Network Information	⌘-F
Router Statistics	⌘-T
Router Log	⌘-L

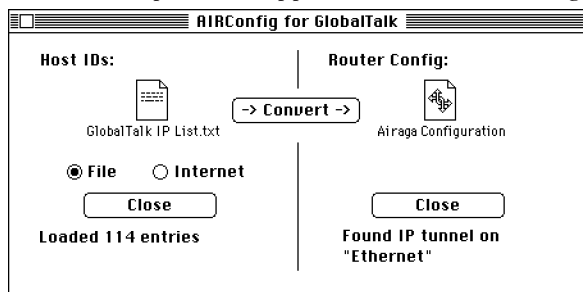
Control
Start Router... ⌘U
Set Startup... ⌘B
Reset Statistics... ⌘R
Set Password...
Remove Password

Windows
Network Information ⌘F
✓ Router Statistics ⌘T
Port Statistics
Router Log ⌘L
Airaga Configuration

afp:/at/AIR Admin’s Guide Server:Airaga/AIR Administrator’s Guide f

AIRConfig

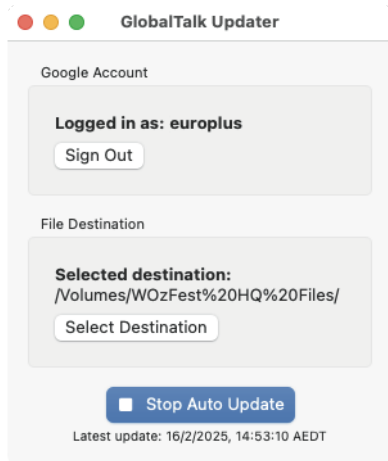
This utility simplifies configuring the nodes within Router Manager by using a text file of Host IDs to update the Apple Internet Router settings file.



```
afp:/at/Blackbird:BaroNet/Blackbird Public/#MARCHintosh #GlobalTalk stuff
```

GlobalTalk Updater

This utility for modern macOS creates a text file of Host IDs by downloading a list of Host IDs from the coordinating Google Sheet (and can do so periodically). Use in conjunction with AIRConfig and save the text file where AIRConfig can see it.



```
https://github.com/dremin/globaltalk-updater
```

◆ **Note** To gain access to the coordinating Google Sheet, GlobalTalk Updater requires you to authenticate to your Google Account. ◆

◆ **Note** GlobalTalk Update resolves hostnames in the coordinating Google Sheet to avoid MacTCP v1's CNAME resolution limit—to ensure the most up-to-date information, utilise the auto-update feature. ◆

Pre-prepared Host ID files for AIRConfig

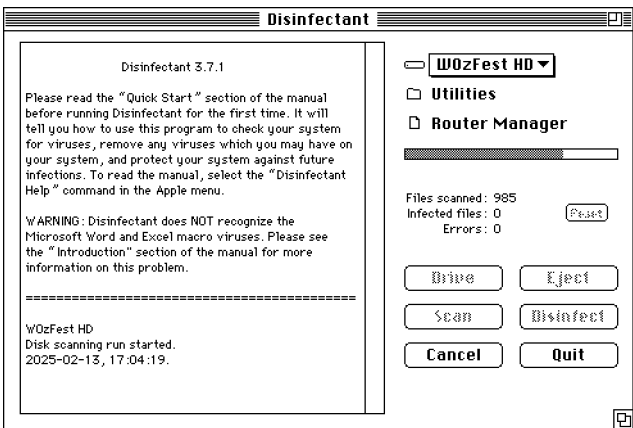
Some GlobalTalk admins Host ID files for use in AIRConfig by other admins, for example:

`afp:/at/MacServ:Daniel's Lab/Public/NOC/`

`afp:/at/Pluto:Purrtopia/Files/`

Disinfectant[🍏]

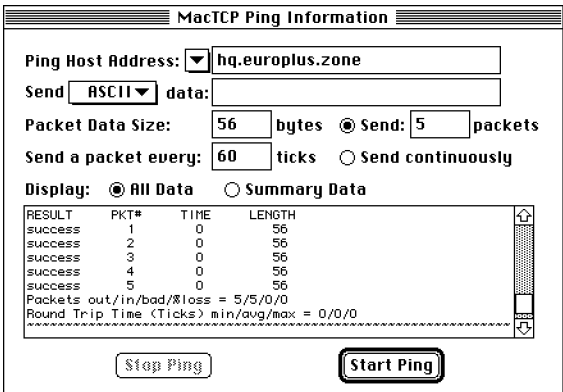
The venerable virus checker and cleaner for Classic Macs. Includes an INIT/extension to protect a System “on the fly”.



`afp:/at/AIR Admin's Guide Server:Airaga/AIR Administrator's Guide f`

MacTCP Ping[🍏]

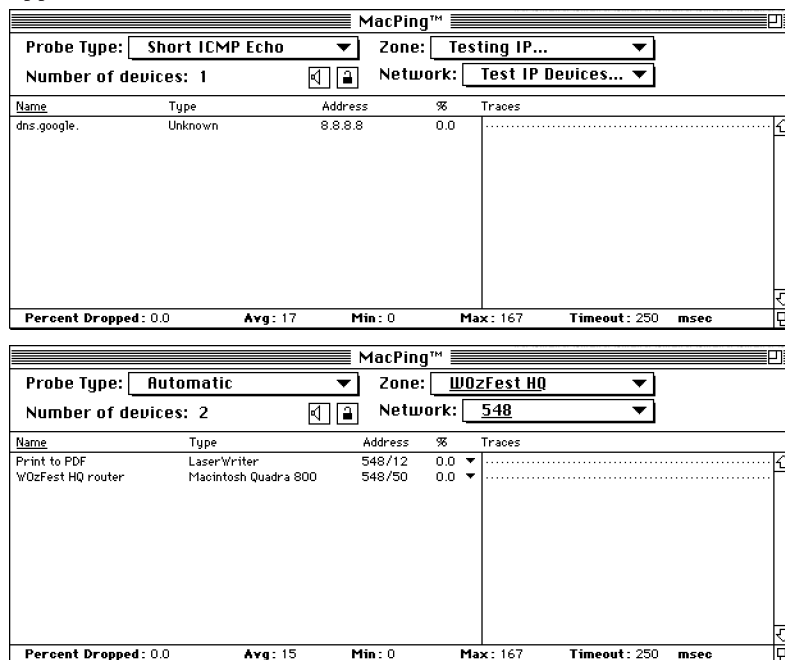
MacTCP Ping is useful for troubleshooting your network router's internal and external networks, including for testing against the addresses in the coordinating Google Sheet to see if your Apple Internet Router host is having trouble seeing other nodes at the IP level.



`afp:/at/AIR Admin's Guide Server:Airaga/AIR Administrator's Guide f`

MacPing Pro

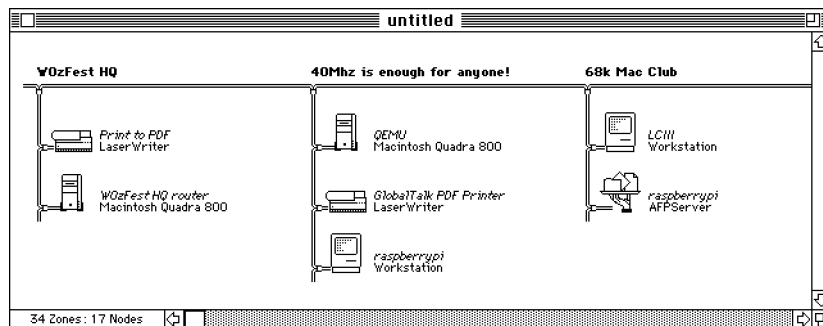
Another useful IP ping utility, MacPing Pro also allows pinging AppleTalk devices on an AppleTalk network/internet.



afp:/at/AIR Admin's Guide Server:Airaga/AIR Administrator's Guide f

Trawl

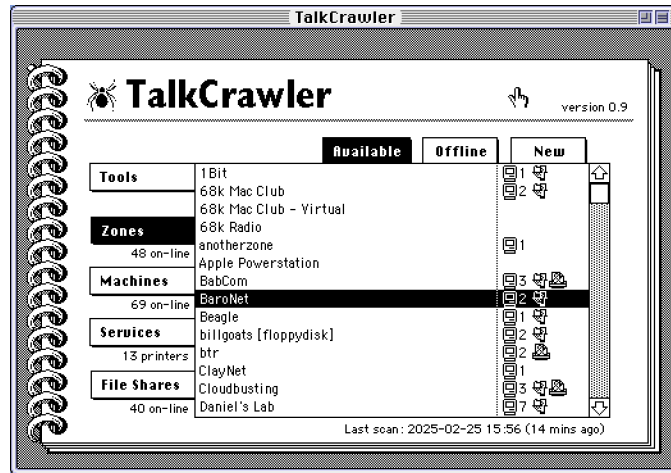
A graphical network discovery tool which displays network diagrams of AppleTalk networks and segments.



afp:/at/AIR Admin's Guide Server:Airaga/AIR Administrator's Guide f

TalkCrawler

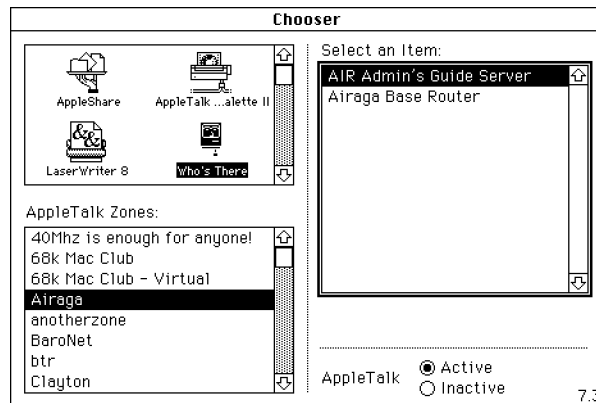
In the lead up to MARCHintosh 2025 [@kalleboo](#) has been developing TalkCrawler, an all-new HyperCard-based tool to crawl the entirety of the GlobalTalk internet in order to keep tabs on all the new zones and machines which have shown up—even while you're asleep! A must-have tool for MARCHintosh 2025—and many more in the future!



afp:/at/Blackbird:BaroNet/Blackbird Public/#MARCHintosh #GlobalTalk stuff

Who's There

An exceedingly useful Chooser extension which displays all devices registered in a zone, as well as some pertinent information about the selected device.



AIR Admin's Guide Server :AFPServer @Airaga On Network:
19680(0x4CE0) Node: 50(0x32) Socket: 250 (0xFA)

Copyright © 1990 Kevin W. Ramer

afp:/at/AIR Admin's Guide Server:Airaga/AIR Administrator's Guide f

Inter•Poll Admin

A network discovery tool which displays network information for AppleTalk networks and internets. Includes MacDraw-compatible PICT files with node icons and office layout grids.

Network Search

Select Zone(s):

Vintage

Vintage Computer Garage

Vintage Computer Garage LT

Woodland Digital Studios

W0zFest HQ

Total Zones: 34

Search Time:

1

Min

30

Sec

☐ Continuous

Select Sorting:

Net

☒ Ascending

☐ Descending

☒ All Named Devices

☐ Devices Matching:

Match

Net

 With

☐ Exact Match

☒ Partial Match

Add

Clear

Clear All

Search Criteria:

Searching for All Devices

in Zone: W0zFest HQ

Cancel

Start

Device List

Status:

Clear

Stop

Searching for All Devices

Zone: W0zFest HQ

Total Entries: 14

Search Time: 1 Min 30 Sec

Search Time (%)

0

50

100

Net	Node	Name	Type	Zone
548	12	server	ProDOS 16 Image	W0zFest HQ
548	12	server	Apple //gs	W0zFest HQ
548	12	server	Apple //e Boot	W0zFest HQ
548	12	server	Workstation	W0zFest HQ
548	12	server	netatalk	W0zFest HQ
548	12	Brother From Another...	LaserWriter	W0zFest HQ
548	12	Print to PDF	LaserWriter	W0zFest HQ
548	12	server	TimeLord	W0zFest HQ
548	12	W0zFest HQ Server	AFPServer	W0zFest HQ
548	50	W0zFest HQ router	Workstation	W0zFest HQ
548	50	W0zFest HQ router	SNMP Agent	W0zFest HQ
548	50	W0zFest HQ router	MsgReceiver	W0zFest HQ
548	50	W0zFest HQ router	Macintosh Quadra 8...	W0zFest HQ
548	50	W0zFest HQ	AppleRouter	W0zFest HQ

Device: Net: 548 Node: 12
Brother From Another Router - LaserWriter - W0zFest HQ

Packets:

20

Interval:

2.5

 Secs

Timeout:

1.5

 Secs

Using:

☐ Echo Pkts

☒ Printer Status Packets

☐ System Info Packets

Packets Sent: Rcvd: 25 Left: 13 Lost: 0 Total: 25

Current

Average

Minimum

Maximum

Hops Away

0

0.00

0

0

Delay (secs)

0.00

0.00

0.00

0.00

Status:

status: idle; info: "Brother" is ready ;

Stop

Done

Clear

afp://at/AIR Admin's Guide Server:Airaga/AIR Administrator's Guide f

A-40 Chapter 11 The GlobalTalk Network

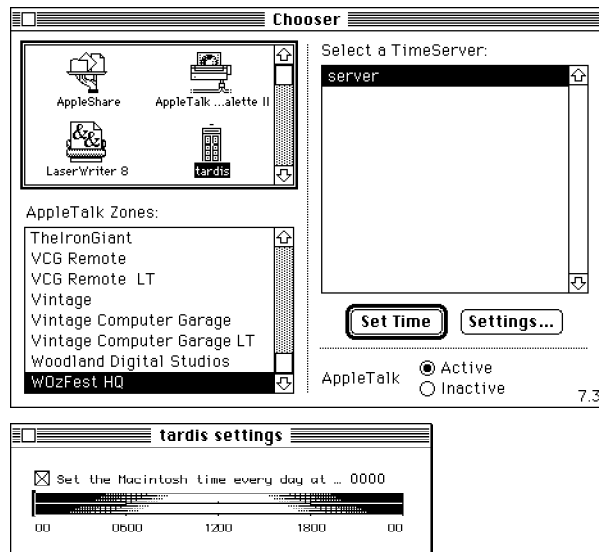
Choosier

If you can get it running (I couldn't, hence no screenshot), Choosier is a Classic Mac OS replacement for Apple's own Chooser, with a raft of improvements over the default app to make network device discovery easier.

`afp:/at/AIR Admin's Guide Server:Airaga/AIR Administrator's Guide f`

timelord/tardis

The timelord time synchronisation package allows your AppleTalk-connected Classic Macintoshes to synchronise their time from an AppleTalk Classic Mac timelord server via the tardis Chooser extension.



Additionally, Netatalk has a timelord server, allowing the tardis client machine to be updated via the standard Network Time Protocol (NTP).

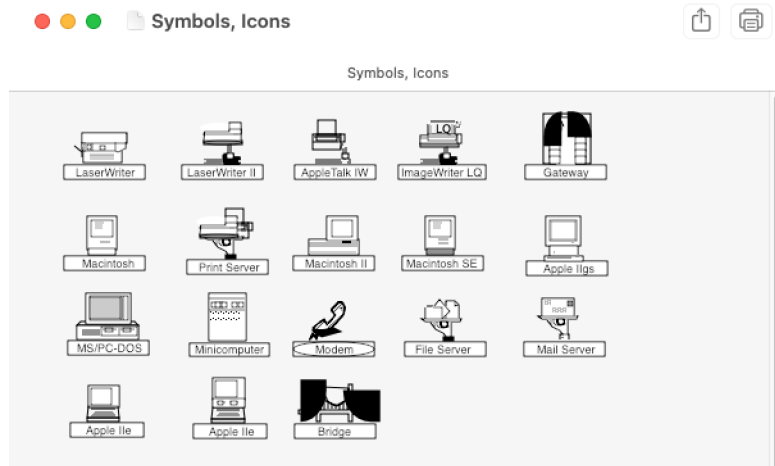
Clock drift is certainly not uncommon on some emulated systems, so this can help to periodically correct the emulated system's time.

◆ **Tip** Rename “tardis” to “zardis” so it is the last Chooser extension shown—it is rarely used, works with the changed name, and allows more regularly-used Chooser extensions, such as Who's There, to appear higher on the small Chooser extensions pane. ◆

`afp:/at/AIR Admin's Guide Server:Airaga/AIR Administrator's Guide f`

QuickDraw Viewer

A utility for modern macOS for viewing QuickDraw files, such as PICT files (including screenshots) from Classic Mac OS.



<https://github.com/wiesmann/QuickDrawViewer>

Mac OS X/Netatalk command line AppleTalk utilities

atlookup (Mac OS X)

On the command line, `atlookup` allows Mac OS X (v10.4 and below) to perform lookups on the AppleTalk network, including on AppleTalk internets like GlobalTalk. By default, `atlookup` lists all devices in the current zone. An example to look for all devices in the “Airaga” zone would be:

```
atlookup =:@'Airaga'
```

where the “=” acts as a wildcard.

To get the list of visible zones on the AppleTalk network/internet, use the “-z” switch:

```
atlookup -z
```

nbplkup and getzones (Netatalk)

On systems with Netatalk installed, nbplkup (AppleTalk Name Binding Protocol Lookup) performs a similar task to atlookup in older Mac OS X versions. An equivalent of the above atlookup command in Netatalk would be:

```
nbplkup '@Airaga'
```

To get the list of visible zones on the AppleTalk network/internet, use the getzones command.

Experimentation on the command line

As with all command line tools, the above can be combined with other command line tools to create complex composite commands. For example, in March 2024 [@paulrickards](#) posted this composite command for Netatalk 2 on [Mastodon](#):

```
getzones | while read line ; do echo "$line zone:" ; nbplkup "$line" ;done
```

Which will trawl all visible zones on an AppleTalk network/internet (including the GlobalTalk network) and list all visible devices in each zone.

It's left as an exercise for the reader to remove the additional output which appears in Netatalk 4.

Mind the (AIR) gap—other AppleTalk bridges and routers

Apple Internet Router is not the only kid on the block when it comes to AppleTalk routers. Other solutions existed contemporaneously in hardware and software, and there continues to be development of new applications and devices to undertake some or all of Apple Internet Router's roles. We look at some here . . . and look forward to others being developed in the future.

Solutions contemporaneous with Apple Internet Router

LocalTalk Bridge

Apple released LocalTalk Bridge as a way to use a computer which could connect to LocalTalk and, say, EtherTalk to bridge between the two networks so devices could access those on the other connection.

Most useful on real hardware, its functionality is likely superseded for most, if not all, GlobalTalk admins with Apple Internet Router itself.

While similarly named and sharing much of the same GUI (and presumably underlying code), LaserWriter Bridge allows only a single LocalTalk Apple LaserWriter to be shared to the other network/s the Macintosh is connected to.

GatorBox

The GatorBox was a hardware solution by Cayman Systems which combined several AppleTalk-related features.

It was able to bridge between LocalTalk and EtherTalk networks, it could seed networks with network number and zone information, it could provide AppleTalk access to Unix line printers (lpr) it was connected to, and it could perform TCP/IP bridging to LocalTalk devices (similar to MacIP Gateway, part of Netatalk) so they could access TCP/IP services without an Ethernet connection.

Cisco

AppleTalk is supported on Cisco IOS 12.1 and earlier. By IOS 12.2 Cisco started deprecating AppleTalk features. It was completely removed in the 15.0(S)M release. An older Cisco router can be used to route and manage AppleTalk EtherTalk (LocalTalk is not supported). Cisco IOS can handle a few other routing protocols as well such as GRE (Generic Routing Encapsulation) for tunnelling AppleTalk across the Internet.¹

¹Text supplied by [@danielrufvesson](#).

Modern solutions

These products are modern developments which can help in connecting old and modern AppleTalk devices to each other, in some cases including emulated Macintoshes.

While beyond the scope of this chapter to detail configuration, etc., some basic details and links to product websites may help GlobalTalk node admins determine if these products will be useful in their setup.

jrouter

A modern replacement for Apple Internet Router written in Go—a work in progress at the time of writing, it is an ongoing MARCHintosh project of [@DrJosh9000](#).

Running [jrouter](#) allows a modern computer to perform the routing functionality without the real or emulated Classic Mac OS device Apple Internet Router requires.

TashTalk

[TashTalk](#) is a hardware device which converts LocalTalk traffic received through a LocalTalk dongle (including PhoneNet) into UDP traffic using the LTtoUDP translation, which allows modern LTtoUDP-aware software (e.g. Mini vMac) and hardware to be bridged to LocalTalk devices directly.

TashRouter

From the same developer as TashTalk, the [TashRouter](#) is described on its website as “a fully standards-compliant AppleTalk router that supports LocalTalk (via LTtoUDP and/or TashTalk) in addition to EtherTalk”. It can, for example, replace bridges like the AsanteTalk devices, which do not bridge networks in a standards-compliant way.

AirTalk

[AirTalk](#) is a device which extends LocalTalk networks over WiFi. Powered via USB or ADB, it allows connection directly to individual LocalTalk devices with a serial cable, or to LocalTalk networks via transceivers.

StarTalk/LT

The [StarTalk/LT](#) is an experimental device which acts as a hub for LocalTalk networks.

Because it acts as a hub, it can be used to “mix-n-match” original Apple LocalTalk-based networks with PhoneNet-based networks.

Currently in prototyping/experimental status, the files to allow those with the capabilities to build their own are on the GitHub page linked above.

Security on GlobalTalk

In this day and age, security concerns are paramount, so it's worth keeping in mind the security- and privacy-related challenges of being an administrator on GlobalTalk.

Google account

To access the GlobalTalk coordinating Google Sheet, a Google account is needed, and all those to whom the Sheet has been shared appear in the list of those able to access the Sheet, showing the e-mail address associated with those Google Accounts.

You may wish to create a separate Google Account tied to an e-mail address specifically for GlobalTalk use if this is a concern for you.

IP address/hostname

The external IP address and/or hostname of your Apple Internet Router node's network is listed in the Google Sheet to aid connection between nodes.

Not placing an entry in there won't prevent you from connecting to other nodes, but as described above in this chapter, the most reliable way to maintain connections is to allow your IP address/hostname to be added to other nodes' configuration to more easily recover from downtime.

◆ **Note** It is bad form to share others' details without their consent—this is especially true for e-mail addresses, real names, IP addresses and domain names which are provided by node administrators on the coordination Google Sheet for GlobalTalk-related use only. Please be mindful of this when sharing any GlobalTalk details, not limited to screenshots which may include such information. If in doubt, reach out—a simple request will allow you to accommodate others' preferences. ◆

Port forwarding

Any port which is forwarded to a device on your network is a small door open into your network.

All administrators must consider if they're happy to have a port forwarded to a device on their network, although in the case of Apple Internet Router nodes, there are likely to be few who are trying to attack these, or have access to available exploits for wider internal network access.

One mitigation might be to implement firewall rules which, for example, only allow port 387 to be forwarded when originating from a known GlobalTalk host. It is beyond the scope of this addendum to detail how such a configuration can be achieved.

Insecure services

Many of the AppleTalk services on GlobalTalk are unencrypted, allow files to be left on other servers, allow Guest access, etc.

These are all security issues in the modern world, but many administrators allow them to occur on GlobalTalk due to the (likely) limited scope to cause significant damage.

Berserk print jobs

Sometimes printing goes awry and instead of the nicely formatted output on a printer, the underlying printer code is spewed out in text, often with very little on each page, and going on for quite some time.

Keep the first print jobs you send to a printer simple until confirmed working, and if you provide access to a printer on your node, maybe leave only a few pages in the printer so berserk print jobs do limited damage.

Viruses

Yes, there has been a virus outbreak (nVIR) on GlobalTalk, although damage was, as far as the author is aware, non-existent.

This outbreak originated from a reliance on disk images prepared and made available through public forums by others—a not uncommon practice in retrocomputing circles—which were then modified and expanded and made available again without virus checking.

In fact, the author's own set of disk images were infected via this path, as were others'.

A salutary lesson, indeed.

Administrators are therefore strongly recommended to install [Disinfectant](#) and the Disinfectant INIT (or other reputable, period-appropriate antivirus software) on their Classic Macintoshes, and in the interests of the security of their own files and OSes, should remain vigilant when using any resources prepared by others.

△ **Important!** It is ultimately each administrator's personal responsibility to confirm they are happy with all access and services originating through their involvement in the GlobalTalk network. △

A vision of GlobalTalk's future

It is 2036, and the Internet as we know it is long dead, reduced to a feudal wasteland of app-only walled gardens.

All important communication is confined to 400kb MFS floppy disks, taped under trash can lids and park benches by clandestine revolutionary types.

'Encryption' is a rare experimental font (Zapf Dingbats v0.35b) released in 1985. Any System 7 Macintosh with a working floppy drive is now worth four dozen eggs—an amount unheard of since the Chicken Panic of '27.

After the post-crisis shakeup in '34, we were lucky to gain a person on the inside.

There was a loophole exploit that allowed them to disable National AI Snooping™ on UDP port 387 from UTC 0300–UTC 0400 every Thursday, during the weekly Lords of Capital meeting.

And thus it began. The #GlobalTalk Revolution of 2036.

Our international flag of unity is the cool crab pride flag, with the motto, “Live, Laugh, LocalTalk ⇄” inked in Chicago across the bottom...

[@likesoldmacs](#), January 2025

